and so that accurate satellite positions can be useful for geodetic purposes.

The basic problem in satellite tracking consists of obtaining, with comparable accuracy, the position on the celestial sphere (during morning and evening twilight periods) and the time such position is occupied, of an object of magnitude 5 to 10, moving at an apparent angular rate of approximately 1000 to 5000 seconds of arc per second of time. Since, in practice, time can be measured to the order of one millisecond, an accuracy of one to five seconds of arc along the satellite path is desirable.

Because of the high angular speed of the satellite, a short focal-length camera is called for, yet one that is long enough so that one second of arc is represented by a few microns in the focal plane.

An $f/1$, twenty-inch Schmidt system will meet both speed and focal-length requirements. It is expected that the telescopic cameras will be used in fixed position, except when the satellite is very faint, with timing marks imposed as breaks in the satellite trail. The Schmidt cameras will be used at twelve primary stations geographically spread through an appropriate range of latitude and longitude. The locations of these stations has not yet been finally decided.

Since for each satellite launched a preliminary orbit is necessary for positioning of the telescopic cameras, corps of visual observers are being organized under the direction of Mr. Armand Spitz. Such visual observers, using a network of fixed binoculars, will be especially needed in the early and late stages of the satellite's existence.

The optical tracking program does not carry military classification and the Smithsonian Astrophysical Observatory, which has been assigned the task of initiating this program, will also assist in the compilation and exchange of scientific data obtained through the use of this new scientific vehicle.

*Smithsonian Astrophysical Observatory,
Cambridge, Mass.*

**Whitehurst, Robert N. and Mitchell, F. H. A
Dicke-type radiometer for the 7-8 mm wave-length range.**

A Dicke-type radiometer has been constructed for the 7-8 mm wave-length range. Measurements have been made of the sun's temperature, a typical value at 7.5 mm being $6000^{\circ} \pm 500^{\circ}\text{K}$. Preliminary values for the total vertical attenuation in the earth's atmosphere are in general

agreement with the Van Vleck theory. The instrument will be described and more detailed results presented.

This work has been supported by the University of Alabama Research Committee.

*University of Alabama,
Tuscaloosa, Ala.*

Whitney, Charles. The velocity humps of classical Cepheids.

The humps on the ascending branches of the radial-velocity curves of η Aql and S Sge may be removed by subtracting one cycle of a nearly-sinusoidal curve. These "hump curves" have periods of about one-half the pulsation periods and semi-amplitudes comparable to the velocity of sound in these stellar atmospheres.

It is suggested that the hump wave may arise from a pressure disturbance which generates an inward- and outward-running pulse, once each cycle. This pressure disturbance may arise in that portion of the hydrogen-ionization zone in which the ratio of specific heats, γ , varies significantly in space and time. Departures from adiabatic conditions may also play a role.

Ledoux (1953) has called attention to the possible effects of the space variation of γ . Consider now the effect of time variation, and relate the argument to mean molecular weight, μ , or degree of ionization, rather than γ . The density variation will be non-sinusoidal because it is of finite amplitude. The resulting variation of μ will induce, in the pressure changes, further departures from a sine curve. These further departures may generate the pulse associated with the hump wave.

The following argument suggests that the energy involved in the hump wave may be derived from variations of mean molecular weight. The hump-wave energy is estimated to be about 5×10^{14} ergs per cm^2 of stellar surface.

The potential energy of a gas element is $P_0 V_0 / (\gamma - 1)$. If the mean molecular weight, μ , is changed with no corresponding changes of temperature or density, the increase of potential energy is $-[P_0 V_0 / (\gamma - 1)] (\Delta\mu / \mu)$. Examination of a model for η Aql (Dumézil-Curien 1954) shows that, for the ionization zone, $P_0 V_0 / (\gamma - 1)$ is about 10^{17} ergs cm^{-2} and that μ will change by several per cent during the pulsation. Therefore the available energy, 2×10^{15} ergs cm^{-2} , appears sufficient to account for the hump wave.

The inward-running pulse will be reflected at the center of the star and will subsequently run